9.—The Fossil Mammalian Fauna of the Burramys parvus Breccia from the Wombeyan Caves, New South Wales

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Manuscript received—16th February, 1960

A sample of Robert Broom's original material from the type locality and horizon of *Burramys parvus, Palaeopetaurus elegans, Pseudochirus antiquus, Macropus wombeyensis, Potorous tridactylus antiquus, Perameles wombeyensis,* and *Mastacomys wombeyensis* has been analysed. It is a very porous tufa crowded with bones, and with occasional fragments of coarsely crystalline calcite. Both are covered with a thin layer of fine dust and then with layers of cementing calcite. The deposit was probably accumulated by owls. The murids *Pseudomys oralis* and *Gyomys glaucus* and the phalanger *Eudromicia lepida* are recorded from the Pleistocene for the first time. *Eudromicia lepida* is today confined to Tasmania. Those species in the fauna that are not extinct, occur today in eastern Australia. The climate of the district at the time of deposition was probably closer to that of modern Tasmania than to that of the locality today. The age of the deposit is probably Upper Pleistocene. More information about the ecology of modern species is needed and taxonomic revisions are required.

Contents

Introduction

During the years at the end of the last century that the great palaeontologist and comparative anatomist, Robert Broom, worked in Australia, he described a fossil mammalian fauna which he collected from a depression on a hillside above the Wombeyan Caves, New South Wales (Broom 1896 *a, b, c*). The deposit is an exceedingly rich accumulation of small bones which are cemented in a limestone breccia. Among the animals which Broom described from this deposit is the problematical phalangerid *Burramys parvus* which is to date only known from this locality. Since its description, *Burramys* has played a considerable part in phylogenetic speculation on the origins of the Macropodidae, the family which includes the modern kangaroos and wallabies (see Ride 1956*a*). The fauna is also unique since it contains five other fossil marsupials and the fossil murid *Mastacomys wombeyensis* (Ride 1956*b*) which are also to date unknown from other deposits.

The age of the fauna is at present unknown although both Broom and Ride consider it to be Pleistocene.

Cave breccias and the more obvious members of their faunas have long been well known from many parts of Australia and many of our known Pleistocene and sub-modern mammals have been described from them; but little is known of their absolute ages or even of their ages relative to each other. For certain localised areas at this time, C^{14} dates are becoming available and it is hoped that, in the near future, the absolute ages of at least the more modern of some of these faunas will become known. In the meantime, faunal comparisons still provide the most workable basis upon which to base relative ageing.

In this paper is given the result of an analysis of a sample of Broom's original material from his Wombeyan Caves deposit in terms of the specific identity and relative abundance of mammals which it contains. This provides a picture of the faunal composition of the type locality and horizon of *Perameles wombeyensis* Broom, *Palaeopetaurus elegans* Broom, *Burramys parvus* Broom, *Pseudochirus antiquus* Broom, *Macropus wombeyensis* Broom, *Potorous tridactylus antiquus* Broom, and *Mastacomys wombeyensis* Ride.

Method

In the Broom collection in the Anatomical Museum at Edinburgh there are a number of large pieces of breccia which contain the remains of many individual mammals. Nine of these pieces have been broken down by the acid-technique (see Ride 1956*a*) so that all the contained bones have been freed; the separate bones have then been identified so that some quantitative estimate of abundance can be made. Owing to the fact that no associated remains (i.e. associated as in life) have been found, it has not been possible to identify postcranial fragments with any certainty, so that this analysis is entirely based upon those fragments which are tooth-bearing.

Samples containing the remains of a large number of individuals which have disintegrated before being preserved present a problem in that there are different methods which might be used in the estimation of the total number of individuals present. Here no hard and fast rule has been adhered to such as that of only

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recording right mandibles, but, if in one species there are found to be four right fourth lower premolars then it is recognized that there must be at least four individuals present in the sample. Another species might have the number of individuals estimated by another feature.

It will be seen that some of the species described by Broom are not included in the table of relative abundance (Table I). These missing species happened not to be represented in the sample of nine pieces of breccia. A list of the total known fauna of the breccia is given in addition to the table of relative abundance.

The identification of new specimens of marsupials of Broom's fossil species was made by comparing all specimens with specimens identified by him and included in his Edinburgh Collection. No revision of the status of these species has been made. *Eudromicia lepida* was not previously obtained by him and, in this case, the five specimens (mandibles and maxillae) were compared with the excellent series in the British Museum (Nat. Hist.)

The Muridae present a greater problem in identification since there is a superabundance of named forms, particularly in the *Pseudomys* group of genera, some of which are certainly synonyms. Since most of the marsupial genera represented in the breccia are also included among the Recent fauna of Australia, I have assumed that most or all of the murines would also prove to belong to Recent Australian murine genera. Direct comparison with specimens in the British Museum was made with all of these.

Australian Murinae may be divided into three groups (see Tate 1951) which are: Group 1. "modern introductions". e.g. *Rattus rattus, R. norvegicus, Mus musculus;* Group 2. "young endemics", e.g. species of *Rattus* which have probably evolved in Australia, including the *R. assimilis* and *R. lutreolus* species groups; Group 3. "old endemics", i.e. Murinae of genera peculiar to Australia and the adjacent islands.

Results

Fauna

Murinae: Groups 1 and 2.—In the identification of fossil murines, specimens of *Rattus* are most easily separated from the rest by means of the characteristic root pattern of the first molar (see Jones 1922) as shown in Fig. 1. No species of *Rattus* were encountered in this deposit, nor was *Mus* (sens. strict.).

Murinae: Group 3.—Of the old endemics, the following genera at present occur in continental Australia and any might have been expected to occur in the sample: *Pseudomys, Gyomys, Thetomys, Leggadina, Notomys, Mastacomys, Leporillus, Zyzomys, Mesembriomys, Conilurus, Laomys. Uromys,* and *Melomys*. Of these genera the last two comprise the Australian mainland representatives of the *Uromys* genus-group which is probably papuan in origin. Tate (1951, p. 283) believes that this group was derived independently from a *Rattus*-like ancestor. The Australian species of the *Uromys* group are mostly tropical forms and are probably fairly recent arrivals in continental Australia.

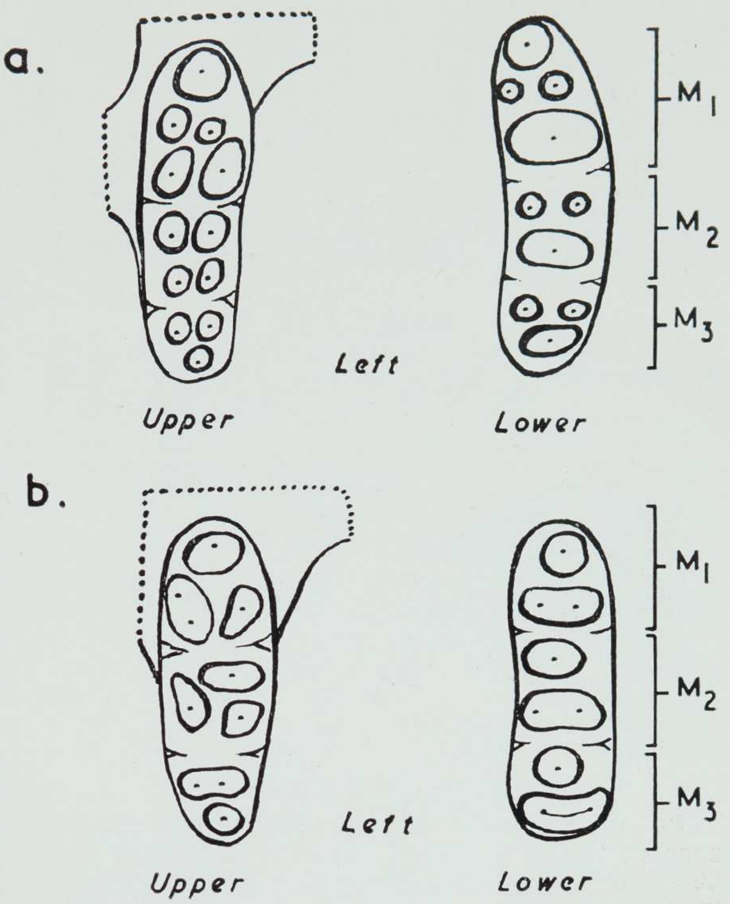

Fig. 1.—The alveolar cavities of Australian murines after Wood Jones (1922). (a) *Rattus greyi* (b) *Leporillus jonesi*.

One would not expect to find them in a southern (New South Wales) Pleistocene fauna and none were obtained.

The remaining old endemic genera constitute the *Pseudomys* genus group. Only three species of this group were obtained and they were found to belong to *Mastacomys, Pseudomys,* and *Gyomys*. A large series of type specimens of these genera is available in the British Museum (Nat. Hist.) and upon comparison with these, the specimens in the deposit were found to agree most closely with the types of *Pseudomys oralis* Thos. and *Gyomys glaucus* Thos. The Mastacomys was new and has received the name *Mastacomys wombeyensis* Ride (1956*b*).

Marsupialia.—In addition to the species already described by Broom, specimens of *Eudromicia lepida* were obtained.

The results of the faunal analysis are summarized in the following list and in Table I.

The following species of Mammalia occur in the deposit:

MONOTREMATA

1. *Tachyglossus* sp. Remains are too fragmentary to allow of specific identification.

MARSUPIALIA

Dasyuroidea

2. *Antechinus flavipes* (Waterhouse.)
3. *Phascogale tapoatafa* (Meyer.)
4. *Thylacinus cynocephalus* (Harris.)

Perameloidea

5. *Perameles wombeyensis* Broom.

Phalangeroidea

6. *Cercaertus nanus* (Desmarest.)

7. *Eudromicia lepida* (Thomas.) New record.
8. *Petaurus breviceps* Waterhouse.
9. *Palaeopetaurus elegans* Broom.
10. *Burramys parvus* Broom.
11. *Pseudochirus antiquus* Broom.
12. *Potorous tridactylus* (Kerr.)
13. *Macropus wombeyensis* Broom.

RODENTIA

Muridae

14. *Pseudomys oralis* Thomas. New record.
15. *Gyomys glaucus Thomas.* New record.
16. *Mastacomys wombeyensis* Ride (Ride 1956*b* as new species.)

TABLE I

Relative abundance of individuals in the fauna of the *Burramys parvus* breccia of the Wombeyan Caves, N.S.W. Only those species which were found in the test sample mentioned above are included.

Species	Number of Specimens	Minimum number of individuals
Antechinus flavipes	14	4
Phascogale tapoatafa	2	1
Perameles wombeyensis	17	3
Cercaertus nanus	26	6
Eudromicia lepida	5	2
Palaeopetaurus elegans	7	2
Pseudochirus antiquus	11	3
Potorous tridactylus	4	1
Pseudomys oralis	10	3
Gyomys glaucus	87	17
Mastacomys wombeyensis	1	1
(*Burramys parvus*)*	(9)	(3)

Petrography of the Deposit

The petrography of the *Burramys parvus* breccia has not previously been investigated and Dr. Pamela Lamplugh Robinson of the Department of Zoology, University College, London kindly did this for me. The following is an extract from her report on the material (personal communication):

> Hand specimen.—A very porous tufa crowded with bones, and with occasional fragments of coarsely crystalline calcite. No layering is apparent, and there is no directional orientation of the bones. The bones do not appear to be abraded by an agent of transport such as water or wind.
>
> Thin section.—The fragments of crystalline calcite, and the majority of the outer surfaces of the bones are covered with a thin layer of extremely fine brownish dust. Then follows a layer or layers of calcite containing a fine dispersion of dust. The remaining interstices between calcite fragments and bones may either be unfilled with cementing calcite (in which case the cavity commonly has a lining of a thin layer of clear calcite) or be filled with clear cementing calcite. The interior of the bones may be hollow, or lined with a thin layer of calcite, or completely filled in with calcite.

Discussion

Several aspects of this breccia and fossil fauna require discussion. First, there is the provenance of the bones and the mode of deposition of the deposit; second, there are zoogeographic and palaeoclimatic implications; and third, there is the age of the fauna. Finally, certain general principles emerge.

*Three of the pieces of breccia where chosen for treatment because a mandible of *B. parvus* was present on the surface so that the results for this species are not strictly comparable. If these three specimens are ignored, the results for *Burramys* are six specimens comprising at least one individual.

Provenance of the Bones and Mode of Deposition

Great concentrations of small bones such as occur in the *Burramys* breccia are a familiar feature of many Australian cave deposits. For example, the cave earth of Hastings Cave, Jurien Bay, Western Australia, which is comparably rich in bone to the *Burramys* breccia, is in places 11 ft thick. Most of the remains of the many hundreds of thousands of individuals which go to make up the bulk of these deposits appear to have been transported into the caves from outside. Further, the bones seem always to have been moved after the bodies have decomposed. since it is only seldom that bones associated in life remain so in the deposit. In Hastings Cave it appears that some of the material is washed down into the entrance. The entrance is a sink hole into which a collapse has left an inclined ramp which leads from the present day surface of the ground through the arched entrance of the main cavern. Bones deposited in the sloping entrance ramp or within the arch itself are thus washed further back into the cave. Some layering is apparent.

In the *Burramys* breccia however, no stream bedding or layering of any kind, or sorting of the bones could be detected by Dr. Robinson, and further, the deposit is extraordinarily free from clay, silt and sand. These facts would appear to discount any suggestion that the bones were transported into the cave by water as some have been at Hastings cave.

Dr. Robinson does not consider that the deposit is wind-accumulated because there are no sand grains or signs of vegetable debris which might be expected if the remains had blown into the cave from outside. She suggests that animal transport is the most likely means by which the bones accumulated and points out that the broken state of these small bones would appear to indicate accumulation by some predator.

The character of the matrix gives further indication of the conditions under which the deposit accumulated. It consists first of fine dust which probably penetrated from outside the cave or which may even have been derived from the ceiling of the cavern itself by decomposition of the limestone and the freeing of contained impurities. This coating of fine dust possibly marks arid periods during the accumulation of the bulk material of the deposit which comprises the bones and the fragments of coarsely crystalline calcite. The bulk of the matrix is a finely crystalline calcite cement which was probably laid down by percolating water. Dr. Robinson considers that deposition was probably slow and the calcite may have been laid down intermittently. This slow rate of deposition was suggested to her by the great concentration of bones in the relatively scanty matrix and by the covering of fine dust which must have taken some time to settle.

An additional point of importance in the understanding of this deposit is the fact that the majority of the remains appear to be those of members of species of small body-size, or of immature individuals of larger species. For example, the larger forms represented in the breccia are *Pseudochirus antiquus, Potorous tridactylus, Perameles wombeyensis, Thylacinus cynocephalus*, and *Macropus wombeyensis*. By the examination of dental wear of isolated teeth, and the stage of tooth eruption reached in mandibles and maxillae, it is possible to obtain a rough estimate of the age of individuals at the time of death; and examination of the material I have prepared shows that, with the exception of a single specimen of *Perameles wombeyensis*, all specimens of the first three species for which age can be estimated are juveniles. This great accumulation of the remains of animals of small size would appear to have been assembled by some definite form of selection. In the case of *T. cynocephalus* and *M. wombeyensis* even the juveniles are large animals as compared with the other mammals of the fauna and these two species appear to be atypical of the deposit in this respect. Remains of these are rare in the breccia and it is possible that they represent fortuitous inclusions. In recent years. I have frequently found the mummified remains of larger mammals among the bones of smaller ones on the surfaces of cave floors. These caves are at present accumulating the dead remains of predominantly small-mammal faunas in Western Australia and the larger bodies which occur in them appear to be the corpses of individuals who either seek refuge in caves in times of distress, e.g. *Macropus ocydromus, Protemnodon irma* and *Vulpes vulpes*, or to be those of individuals which habitually frequent caves and thus stand a reasonable chance of dying in them, e.g. *Macropus robustus* and *Tachyglossus aculeata*.

Broom (1896c) did not recognize that the sample was biased and assumed that the assemblage gave a picture of the whole fauna of the district at that time. He noticed that most of the forms might be classed as "feeble and defenceless" and he concluded from this that they probably flourished "owing to the absence or scarcity of natural enemies" instead of realising that in all probability they died and were included in the deposit *because* they were feeble and defenceless.

The identification of the predator presents a tantalizing problem. The presence of the remains of *Thylacinus* in the deposit would suggest that it and *Sarcophilus* might have been responsible since they are both frequently found together in mainland cave fillings of the late Pleistocene. However, large carnivorous mammals frequently leave some associated bones of their prey such as bones of the feet and these are not to be found in the deposit. The cave-dwelling carnivorous bat *Macroderma gigas* presents a further possiblity. Mr. A. M. Douglas and I have examined the accumulated debris of living colonies of these bats in parts of the Pilbara district of Western Australia in recent years. These deposits are characteristic in that they frequently contain the remains of *Macroderma* itself and moreover contain a large proportion of avian remains but neither of these characters is possessed by the *Burramys* breccia. Finally, owls make use of caves as roosting places and owl pellets of *Tyto alba* and *Ninox connivens* which I have examined lead me to believe that these birds of prey are mainly responsible for the accumulation of the bones in the *Burramys* breccia. Main (1959) has come to a similar conclusion with respect to the extensive deposits of small mammal bones in the caves of the Western Australian aeolianite, and Dr. J. T. Robinson of the Transvaal Museum has told me that almost identical deposits are at present being formed by owls in the caves of the Transvaal.

Zoogeography and Palaeoclimate.

The fauna of the *Burramys* breccia can be divided into three groups:

(1) Those which are extinct today e.g. *Burramys parvus, Palaeopetaurus elegans, Mastacomys wombeyensis, Perameles wombeyensis, Pseudochirus antiquus*, and *Macropus wombeyensis*.

(2) Those which certainly occurred in the area in historic times e.g. *Tachyglossus, Antechinus flavipes, Phascogale tapoatafa, Cercaertus nanus, Petaurus breviceps, Potorous tridactylus, Pseudomys oralis*. Possibly *Perameles wombeyensis, Pseudochirus antiquus* and *Macropus wombeyensis* may prove to be chrono-subspecies of Recent species like *Potorous tridactylus antiquus* and as such could be listed here. *Gyomys glaucus* should also probably be included in this group although its present distribution is Southern Queensland (Tate 1951).

(3) Those which have only existed in historic times in Tasmania, e.g. *Thylacinus cynocephalus* and *Eudromicia lepida*.

The conclusions which can be derived from the evidence of these groups are as follows:

(1) Some of the extinct forms have not as yet been found in any other known deposit of Quaternary or Tertiary age and nothing is known of their distribution. Nothing can be derived from the presence of these.

(2) Of those species which certainly occurred in the area in historic times, *Tachyglossus* and *Phascogale tapoatafa* are widespread in Australia and although local forms of them probably have specific requirements in relation to climate it has not been possible to relate the morphology of the fossils to that of present geographical races and climatic information has not resulted. *Petaurus breviceps* is similarly distributed through both summer and winter rainfall areas in Australia, but here there is some evidence that it is confined to areas of reasonably high rainfall, e.g. south-eastern and eastern Australia, Cape York, the Northern Territory, the Kimberley District, and New Guinea. *Cercaertus nanus, Potorous tridactylus, Antechinus flavipes, Pseudomys oralis* and *Gyomys glaucus* are as far as I can determine confined to areas of abundant rainfall or at least reliable winter rainfall (see

Keast 1959, Fig. 4). This would seem to indicate that the climate of the area at the time of deposition was not much more arid than it is at present.

(3) Two of the mammals of the fauna (*Thylacinus cynocephalus* and *Eudromicia lepida*) are today only found in Tasmania. A case may be made that the mainland extinction of the Thylacine followed the introduction of the Dingo into continental Australia in the sub-modern period, but it is possible that here we do not have cause and effect. Climatic change may be involved. In addition, although we possess scant ecological knowledge, it seems unlikely that the mainland population of *Eudromicia lepida* has become extinct through competition. Its closest relative, and apparent competitor in the mainland Pleistocene, is *Cercaertus nanus* which survives it on the mainland at present but both species still co-exist in modern Tasmania. The extinction of *E. lepida* and *Thylacinus* on the mainland may well be the result of a general environmental change which has resulted from slowly increasing aridity. There is evidence that this has gone on since the last pluvial period and that the present day climate in parts of Australia is as arid, or even more arid, than any period in the Pleistocene (Tindale 1955).

The occurrence of these two Tasmanian forms in the fauna increases the probability that the climate was somewhat wetter and colder at the time of deposition than it is at present.

The occurrence in this area of a Pleistocene fauna which required a colder and moister environment than the area possesses today is not surprising. Only a hundred miles or so to the south, the Kosciusko region was glaciated three times during the Pleistocene and glaciers extended down to 4,800 feet. They covered some 150 square miles (David 1950). At approximately 2,000 feet, and only 150 miles from the centre of the glaciations, the Wombeyan Caves must on several occasions have had a periglacial climate which would have been colder and wetter than at present.

The Age of the Fauna

The advances of geophysics have been such that modern palaeontologists can, in many cases, know the absolute ages of their materials. In the case of the *Burramys* breccia this has not yet been possible. Insufficient bone, and no plant remains, are available for C^{14} dating. However, the palaeoclimatic evidence, which indicates a slightly colder and wetter climate than the area enjoys today, suggests, when taken in conjunction with the nature of the fauna, an age somewhat later than the last pluvial period of the Pleistocene.

Dr. K. P. Oakley of the British Museum (Nat. Hist.) has tried to obtain data by physical methods through which an age relative to other known Australian cave deposits might be achieved, but no significant information resulted. This was largely because sufficient reliable material upon which comparison might be based was not available.

If an attempt is made to correlate faunas of known cave deposits little success is achieved, simply because relevant data are not available. The reasons for this are twofold. First, most authors working in these deposits, with the exception of a few like Finlayson (1933), have not recorded on a total faunal basis, merely confining themselves to descriptions of some of the specimens. Secondly, most of the Pleistocene fossils which have been described are of relatively large animals which are not comparable with these of the Wombeyan Caves. For example, the most obvious recorded faunal assemblage with which to compare the *Burramys* fauna is that of the Wellington Caves, but the recorded fauna from them is one of large mammals. However, the remains of small mammals do occur in this Pleistocene fauna but they are difficult to prepare by manual methods, and when prepared in this way are often even more difficult to identify. Lydekker (1885, p. 227) catalogued specimens of *Mastacomys fuscus, Conilurus albipes,* and *Pseudomys lineolatus* from the Wellington Caves, in the British Museum Collection; these identifications have been confirmed by me and I have obtained further specimens of *P. lineolatus* and *M. fuscus* from a piece of breccia from these caves which was collected by D. M. S. Watson and is now in his collection.

In the geographically close Wellington and Wombeyan Caves it may be chronologically significant that both *Pseudomys* and *Mastacomys* are represented by different species, but, in the case of *Pseudomys,* since both species (see Tate 1951) are extant today it may merely reflect a slight ecological difference between the two areas. Another alternative is that the two species are biologically one since my specific identifications merely record that each specimen is morphologically closer to the type specimen of its assigned name than to any other.

The differences between the species of *Mastacomys* can be similarly dismissed. At first sight the fact that *M. wombeyensis* of the Wombeyan Caves' fauna is extinct and not otherwise known, could possibly imply an even greater age for the fauna than is indicated by the general faunal picture and the evidence of climate. *Mastacomys fuscus* and its subspecies are widely distributed in Pleistocene and Recent south-eastern Australia, and it even extends into cave deposits as far north-west as the Flinders Range of South Australia where it is associated with such typical giant Pleistocene forms as *Thylacoleo* (see Ride 1956*b*). In the Wellington Caves it appears to be associated with *Diprotodon, Nototherium, Thylacoleo, Sthenurus* and *Procoptodon* etc., but there is insufficient stratigraphic evidence to be certain. The *Burramys* fauna could thus be older than these faunas. Unfortunately the validity of the species *Mastacomys wombeyensis* still requires confirmation. It is still only known from a single specimen in this fauna which contains no *M. fuscus*. It differs from *M. fuscus* in two characters, one of which (the great width of the cheek plate in almost unworn teeth) is so distinctly different from that of all other specimens of *M. fuscus* (including *M. f. mordicus*) known to me, that I consider it unlikely that it is not a separate species. The other character, an extra cusp on the third molar, is possibly less reliable. Extra cusps on the molars of the murids of the *Pseudomys* group are not uncommon, for example, the presence of a subsidiary cusp on the inner front edge of M^1 is one of the distinguishing characters of the genus *Thetomys*, but 30% of all specimens of *Pseudomys* and *Notomys* in the collections of the British Museum (Nat. Hist.) also have this as an "abnormality". However, that a character is unreliable in one genus need not necessarily render it so in another. The presence of two apparently unrelated abnormal conditions in a unique specimen is unlikely, but more material is needed to establish the validity of the species.

Even if we accept the validity of *M. wombeyensis*, it is in no way morphologically ancestral to *M. fuscus* (see Ride 1956*b*, pp. 436, 7) and there are no phylogenetic reasons as to why it should occur earlier in time. There can be no reason why the occurrence of two species of *Mastacomys* in eastern New South Wales during the Pleistocene should not be synchronous.

There can be little doubt that the great abundance of murine fossils in the cave breccias will be of great help in future faunal comparisons. Before they can be used, however, we must have a realistic taxonomy of them. Keys to their identification which depend on characters other than numbers of mammae etc., and which provide for the statistical appreciation of individual variation, must also be made before the working palaeontologist can use these species because working collections which are comprehensive enough are not generally available for comparison.

A further distinction between the faunas of the Wombeyan and Wellington caves is one pointed out by Broom (1896*c*). *Trichosurus vulpecula* is absent from the *Burramys* breccia while it is present in the Wellington Caves fauna (Brit. Mus. (N.H.) No. M10789). The absence of *T. vulpecula* from the *Burramys* breccia led Broom to suggest that the deposit accumulated before the species came into the district. Absence from the palaeontological record is always an unsound basis for argument and in this case it is particularly so because the fauna represented is clearly only a selected part of the whole. Even if *Trichosurus* were resident in the area at the time of deposition, adult specimens of it would fall well outside the size range of the included species and it would at most only be represented by occasional juvenile individuals. *Trichosurus* is widespread throughout the greater part of Recent Australia. It is one of the most successful and adaptable phalangeroids. If Broom is right in his contention, then the Wombeyan Caves' fauna is an earlier one than that of the characteristic "giant" fauna of the Wellington Caves. A similar fauna of giant marsupials including *Nototherium* and *Sthenurus* (Mammoth Cave) in Western Australia has recently been dated as >37,000 years (E. Lundelius, personal communication C^{14} date).

In conclusion then, we may say that comparison of the Wombeyan Caves fauna with Recent faunas, together with palaeoclimatic considerations suggests that the fauna is Upper Pleistocene and probably dates from the period since the last pluvial. More slender arguments can be brought forward that the fauna is older than that of the Wellington Caves.

General Considerations.

During the preceding paragraphs one fact has clearly emerged and that is that we do not yet know enough about our faunas to provide a basis for any real comparative discussion. The work which will form the necessary preliminary to the quantitative comparison of faunal assemblages, and their palaeoecological interpretation, is yet to be done. We do not even know much of the ecological interrelationships within modern Australian mammalian communities, and this knowledge must necessarily form one of the premisses of any logical argument in the interpretation of the environmental conditions under which fossil faunas have lived.

In our present state of knowledge, not even fully valid qualitative comparisons can be made because of the uncertain value of many of our species. A number of the species of our fossil and modern mammals are suspect because authors have not made adequate comparisons with other known, and obviously similar, forms. Further, although type specimens are the basis of zoological names, zoological species comprise populations with ranges of variation which, if unknown, can still be more or less predicted statistically in so far as measurable characters are concerned. It is against these ranges of individual variation that specimens which are suspected of belonging to new species must be compared and not merely with the types. The types may actually represent peripheral examples in the range of the species. New names made without biologically intelligent comparison do not advance our knowledge. They merely contribute to the existing confusion.

Acknowledgments

I wish to acknowledge with gratitude the help given me by Drs. K. P. Oakley and P. Lamplugh Robinson. Mr. A. M. Douglas examined deposits left by colonies of *Macroderma* with me, and Mr. B. E. Balme and Dr. J. Glover ascertained the thickness of the Hasting's Cave deposits for me. Drs. A. J. Cain and A. T. Hopwood have spent much time with me in most useful discussion. I am also grateful to Dr. E. Lundelius for allowing me to quote his unpublished C^{14} date for the Mammoth Cave fauna. Finally, the work would not have been possible except for the way in which the Professor of Anatomy, the University of Edinburgh; Professor D. M. S. Watson, F. R. S.; and the British Museum (Natural History); made their specimens available to me for study. Much of the work was done while I held a Christopher Welch Research Scholarship in the University of Oxford. My colleagues Drs. G. F. Mees and A. R. Main read and criticised the manuscript.

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Addendum

(15 August 1960)

In July 1960 I was enabled, unexpectedly, to visit Broom's locality at the Wombeyan Caves. The caves are in a U-shaped ridge of hill which lies as a barrier across the path of a small stream which flows between the arms of the U. The stream disappears into a cave which carries it through the ridge and out of the other side. The ridge contains a labyrinth of caves, the Wombeyan Caves, which open to the exterior as sinkholes.

The Broom locality is well-known to the Caretaker of the Wombeyan Caves Reserve and is a small pocket of breccia in what was probably a solution pipe at one side of a depression on the top of the ridge. This depression is an old cave floor and is littered with typical cave debris. The solution pipe containing the breccia is within ten yards of a sink-hole. This hole is one of the Wombeyan Caves and is called the Guineacor Cave. The old cave floor and the *Burramys breccia* appear to be much older than the modern Guineacor Cave and I propose for them the names Broom Cave and Broom faunal assemblage. To call them by the name of the Guineacor Cave would be misleading.

Since Robert Broom collected at this locality, specimens have been collected by at least Professor R. A. Stirton, Mr. H. O. Fletcher, Mr. J. Mahoney, and myself. There appears to be little of the breccia left today and what remains is rigidly protected by the New South Wales Tourist Bureau and the Caretaker, Mr. Clyde Stiff, to whom I am most grateful for his assistance.